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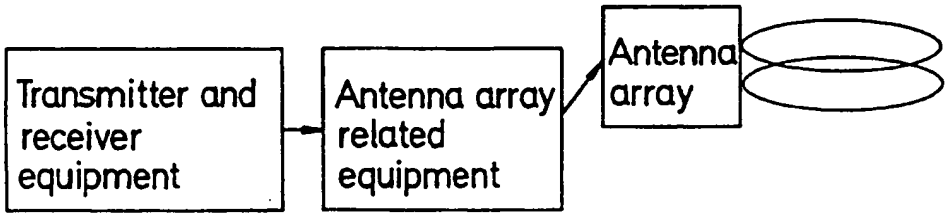
(54) Title: SEAMLESS LOBE HANDOVER



(57) Abstract

The present invention relates to a method in a telecommunication system for communication between mobile stations and base station sites in the telecommunication system. The mobile stations in said telecommunication system, preferably a cellular mobile radio system, move within a site on the same channel by use of seamless lobe or sector handover.

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APPLICANT: RADIO DESIGN INNOVATION TJ AB
TITLE OF INVENTION: SEAMLESS LOBE HANDOVER

Field of invention

The present invention relates to a method in a telecommunication system for communication between mobile stations and at least one base station site in said telecommunication system.

Prior art

Figure 1 discloses a schematic diagram of a flexible lobe shaping system. The antenna array has preferably eight antenna elements.

Each frequency channel has its own set of weights (e.g. $W_1(1) - W_8(1)$ in Figure 1). The number of these weights is determined by the number of antenna elements used.

The number of weight sets is determined by the number of simultaneously channels. Each frequency channel has one set of weights and if SDMA (Spatial Division Multiple Access) is used there must be several weight settings for each frequency channel.

No. Of weight sets = No. of frequency channels × SDMA factor.

No. of complex weights = No. of frequency channels × SDMA factor × number of antenna elements.

The lobe shaping system of Figure 1 is described in detail in the pending applications 9601613-4 (Method and Arrangement of Converting a Cellular Telecommunication System, Applicant: Radio Design AB), 9601615-9 (Rotating Lobe Access Method, Applicant: Radio Design AB) and 9601614-2 (Antenna System, Applicant: Radio Design AB) , which applications are incorporated herein by reference.

A problem with this flexible lobe shaping system is that it is very expensive to implement since much equipment is used.

A less hardware-consuming and thus less expensive solution is the fixed lobe-shaping system as can be seen in Figure 2.

The object of this invention is to avoid the changing of channel when hand-over is carried out in for example the above mentioned fixed lobe-shaping system.

Another object of the invention is to avoid the changing of receiver/transmitter equipment in the base station site.

Brief description of the invention

The above object is achieved by means of a method in a telecommunication system for communication between mobile stations and at least one base station site in said telecommunication system, wherein said mobile stations move within said base station site on a channel by use of seamless lobe/sector handover.

Handover without changing transmitter/receiver equipment implies increased capacity since it results in better trunking efficiency at the base station site.

Other features of the invention are set out in the dependent claims.

Brief description of the drawings

Figure 1 is a flexible lobe-shaping system;

Figure 2 is a fixed lobe-shaping system according to the invention;

Figure 3 is a block diagram of the system in Figure 2;

Figure 4 discloses adjacent fixed lobes with three excited antenna panels according to the invention;

Figure 5 discloses a base station site with three sectors comprising one lobe each, and with one antenna per sector;

Figure 6 discloses a base station site according to the invention with three sectors comprising five lobes each, and one antenna array per sector;

Figure 7 discloses a base station site according to the invention with three sectors comprising five lobes each, and one antenna array for all sectors;

Figure 8 discloses a base station site according to the invention with one sector comprising fifteen lobes and one antenna array for said sector;

Figures 9-12 disclose different structures of the lobe shaping system according to the invention.

Detailed description of an embodiment of the invention

The invention preferably refers to handover between lobes without changing channel. This implies that the mobile terminal can move within a site on the same channel by use of seamless lobe handover. The handover is seamless in the meaning that it can not be noted by the mobile user.

The invention will now be described with reference to Figures 3-12.

Figure 2 discloses an implementation of the block diagram in Figure 3. TRX in Figure 2 corresponds to transmitter and receiver equipment in Figures 3, 9-12. LF1 – LFn and the antennas in Figure 2 correspond to the Antenna array related equipment and the antenna array in Figures 3, 10, 12, respectively.

The cellular mobile radio system of the invention includes several base

station sites and mobile stations (terminals). Each base station site has one or more sectors divided into a number of fixed lobes (Figures 4-8). The base station site comprises base stations with base station transmitter equipment and a base station receiver equipment. The mobile station comprises a mobile station receiver and a mobile station transmitter. The communication in the cellular mobile radio system between a base station site and a mobile station is achieved by the following steps. As mentioned above each base station site uses a number of fixed lobes (Figures 4-8) in accordance with Figures 2, 3, 9-12. A connection is established between the base station site transmitter/receiver equipment and a mobile station. One of the lobes in one of the sectors of the base station site is used for transmission of signals between base station site transmitter/receiver and mobile station transmitter/receiver. The base station site continuously measures the signals received from the mobile station. For example the base station site determines the best lobe by comparing the signal received in actual lobe with signal received in alternative lobes. This can be carried out by comparing received signal strength or by comparing received signal to interference ratio in each lobe.

This comparison between signal strengths etc. in the lobes may imply a handover between the lobes. When the handover is performed the base station site changes utilized lobe of the base station site to another lobe of the same base station site without changing the serving transmitter and receiver equipment, i.e. the base station site uses the same transmitter/receiver equipment for the new lobe.

In another embodiment of the invention the base station site also changes transmitter/receiver equipment when changing lobe.

Thus, the channel is not changed when changing lobe. It should be realized that with channel we mean frequency, time slot, CDMA-coding etc. It should also be realized that instead of effecting handover between lobes as mentioned above, handover between sectors can also be achieved in the same manner.

A number of different handover situations will now be described with reference particularly to Figures 5-12. First the concept "base station site" will be explained with reference to Figure 6. The concept "base station site" in Figure 6 is defined as the covering area of the three sectors, and the base station site includes the three antenna arrays which normally are controlled by three base stations, i.e. one base station for each antenna array.

As mentioned above handover (HO) can be performed between different lobes and different sectors in a base station site. As disclosed in Figure 5 a base station site can consist of three different physical antennas, each connected to a base station, wherein handover can be performed between these antennas (base stations). This is the case in Figures 5, 11 in which lobe/sector handover is performed changing from sector 1 to sector 2. The transmitter/receiver equipment (TRX) controlling sector 1 is changed during handover to another transmitter/re-

ceiver equipment for sector 2. However, the same channel is used.

Another possibility is described in Figures 5, 9. In this case lobe/sector handover is performed changing from sector 1 to sector 2 but the same transmitter/receiver equipment of the base station site is used. The same channel or another channel can be used.

In Figures 3 and 6, lobe handover within a sector is performed without changing transmitter/receiver equipment. Same or changed channel can be used.

In Figures 6 and 12 sector/lobe handover is performed changing from one sector and corresponding TRX1 to another sector and corresponding TRX2. Same or changed channel can be used.

In Figures 3 and 7 lobe handover between lobes 4 and 5 is either performed within a sector or a lobe/sector handover is performed between sectors 6 and 7, wherein handover is performed from lobe 8 in sector 6 to lobe 9 in sector 7. In this case the same TRX equipment is used and the same or changed channel can be used.

In Figures 6, 10 lobe/sector handover is performed changing from one sector to another sector but the same transmitter/receiver equipment of the base station site is used.

The above is only to be considered as a preferable embodiment, and the scope of the invention is only limited by the following claims.

CLAIMS

1. A method in a telecommunication system for communication between mobile stations and at least one base station site in said telecommunication system, **characterized** in that said mobile stations move within said at least one base station site on a channel by use of seamless lobe handover.

2. A method as claimed in claim 1, **characterized** in that said telecommunication system includes said at least one base station site having one or more sectors each divided into a number of fixed lobes comprising the steps of:

- establishing a connection between a base station site transmitter/receiver equipment in said at least one base station site and a mobile station;

- transmitting signals from said base station site transmitter equipment to said mobile station receiver and transmitting signals from said mobile station transmitter to said base station site receiver equipment by utilizing one of said lobes in one of the sectors of said base station;

- changing said utilized lobe of said at least one base station site to another lobe of said at least one base station site without changing transmitter/receiver equipment of said base station site.

3. A method as claimed in claim 1, **characterized** in that said telecommunication system includes said at least one base station site having one or more sectors each divided into a number of fixed lobes comprising the steps of:

- establishing a connection between a base station site transmitter/receiver equipment in said at least one base station site and a mobile station;

- transmitting signals from said base station site transmitter equipment to said mobile station receiver and transmitting signals from said mobile station transmitter to said base station site receiver equipment by utilizing one of said lobes in one of the sectors of said base station;

- changing said utilized lobe and corresponding transmitter/receiver equipment (TRX1) of said at least one base station site to another lobe and corresponding transmitter/receiver equipment (TRX2) of said base station site.

4. A method as claimed in any of the preceding claims, **characterized** in that an antenna array and its supporting equipment is used to form fixed lobes.

5. A method as claimed in any of the preceding claims, **characterized** in that the channel is not changed when changing lobe.

6. A method as claimed in claim 5, **characterized** in that the change of the lobe is made without any signalling or channel order to and from said base station site to control the change of the lobe.

7. A method as claimed in any of claims 1-4, **characterized** in that said channel is changed when changing lobe.

8. A method as claimed in any of the preceding claims, **characterized** in that equipment in said base station site determines the best lobe by comparing signals

received in actual lobe with signals received in adjacent lobes.

9. A method as claimed in claim 8, **characterized** in that signals are compared by detecting received signal strength.

10. A method as claimed in claim 8, **characterized** in that signals are compared by evaluating received signal to interference ratio.

11. A method in a telecommunication system for communication between mobile stations and at least one base station site in said telecommunication system, **characterized** in that said mobile stations move within said at least one base station site on a channel by use of seamless sector handover.

12. A method as claimed in claim 11, **characterized** in that said telecommunication system includes said at least one base station site having a plurality of sectors comprising the steps of:

- establishing a connection between a base station site transmitter/receiver equipment in said at least one base station site and a mobile station;
- transmitting signals from said base station site transmitter to said mobile station receiver and transmitting signals from said mobile station transmitter to said base station site receiver equipment by utilizing one of the sectors in said base station site;
- changing utilized sector in said base station site to another sector in said base station site without changing transmitter/receiver equipment of said base station site.

13. A method as claimed in claim 11, **characterized** in that said telecommunication system includes said at least one base station site having a plurality of sectors comprising the steps of:

- establishing a connection between a base station site transmitter/receiver equipment and a mobile station;
- transmitting signals from said base station site transmitter to said mobile station receiver and transmitting signals from said mobile station transmitter to said base station site receiver equipment by utilizing one of the sectors in said base station site;
- changing utilized sector and corresponding transmitter/receiver equipment (TRX1) of said at least one base station site to another sector and corresponding transmitter/receiver equipment (TRX2) of said at least one base station site.

14. A method as claimed in any of claims 11-13, **characterized** in that said channel is not changed when changing sector.

15. A method as claimed in any of claims 11-14, **characterized** in that said change of sector is made without any signalling or channel order to and from said base station site to control said change of sector.

16. A method as claimed in any of claims 11-13, **characterized** in that said channel is changed when changing sector.

17. A method as claimed in any of claims 11-16, **characterized** in that equipment in said base station site determines the best sector by comparing signals received in actual sector with signals received in adjacent sectors.

18. A method as claimed in claim 17, **characterized** in that said signals are compared by detecting received signal strength.

19. A method as claimed in claim 17, **characterized** in that said signals are compared by evaluating received signal to interference ratio.

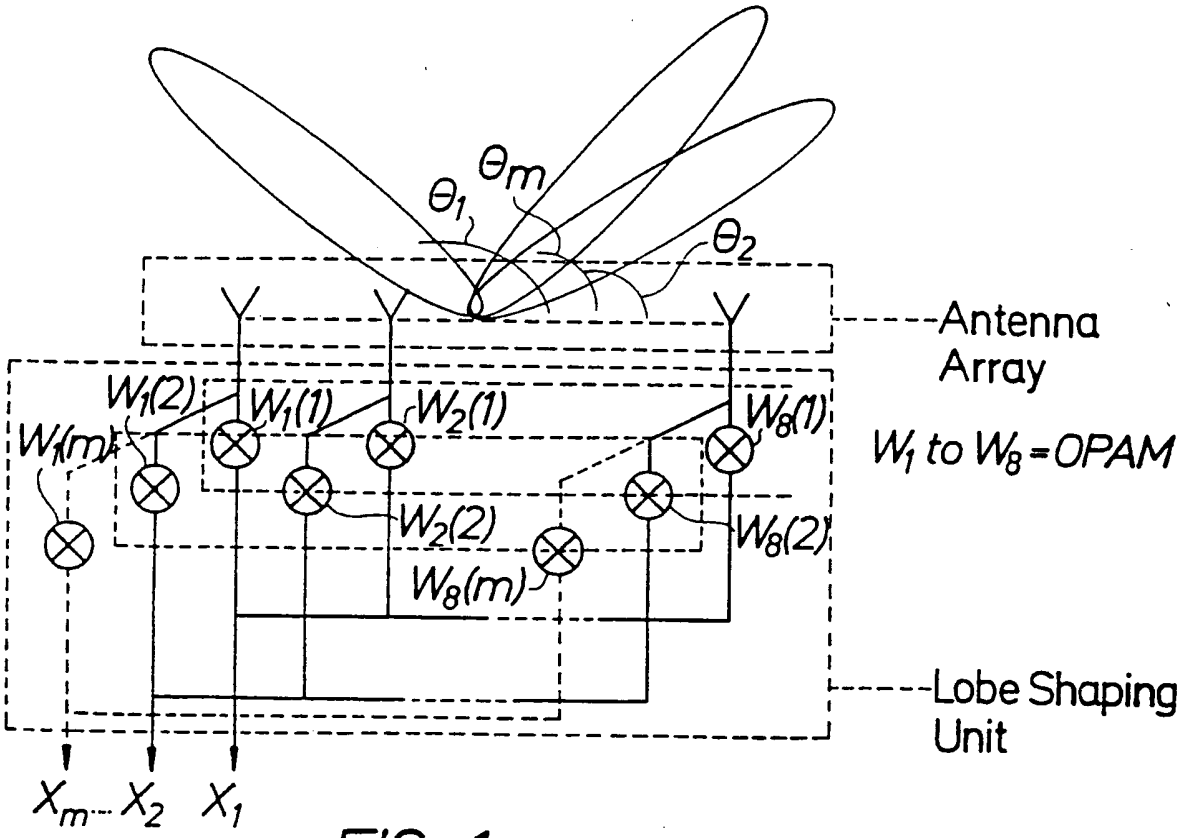
θm
θ1
θ2
Antenna Array
W1(2)
W1(1)
W2(1)
W8(1)
W1(m)
W2(2)
W8(2)
W8(m)
W1 to W8 = OPAM
Lobe Shaping Unit
Xm
X2
X1

FIG. 1

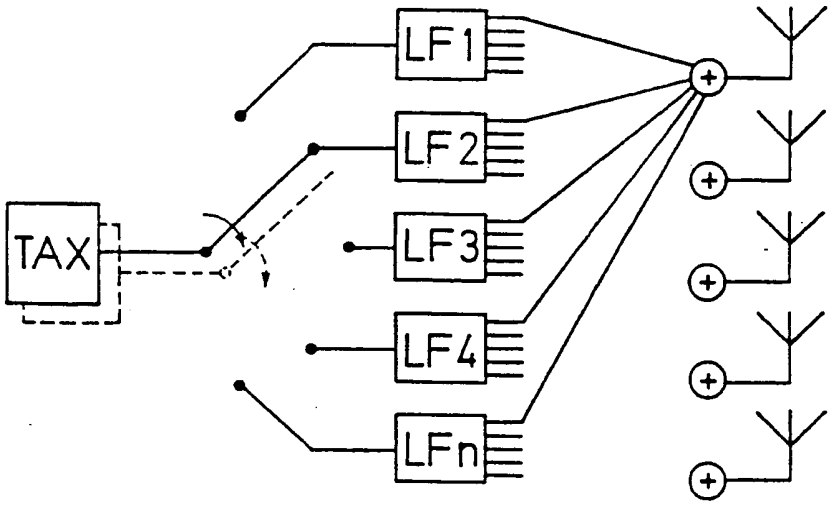
LF1
LF2
LF3
LF4
LFn
TAX

FIG. 2

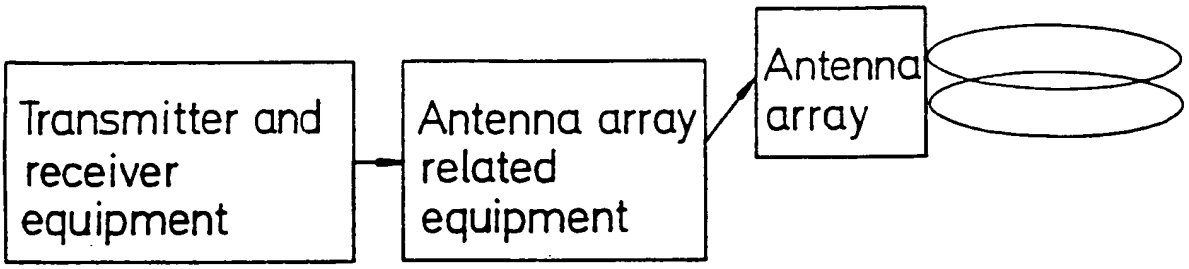
Transmitter and receiver equipment
Antenna array related equipment
Antenna array

FIG. 3

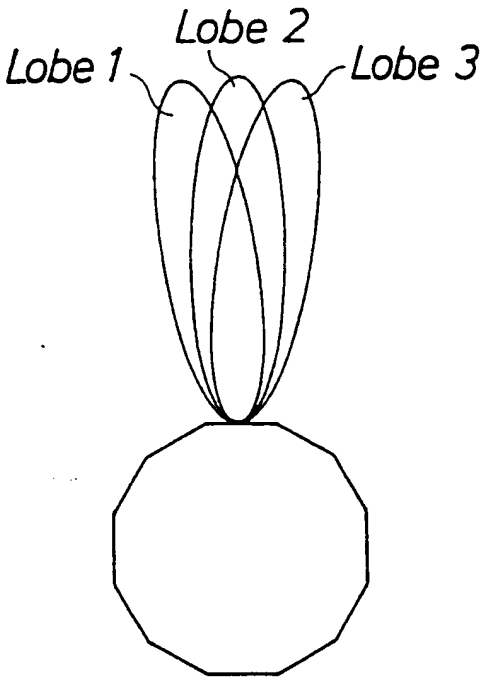
Lobe 1
Lobe 2
Lobe 3

FIG. 4

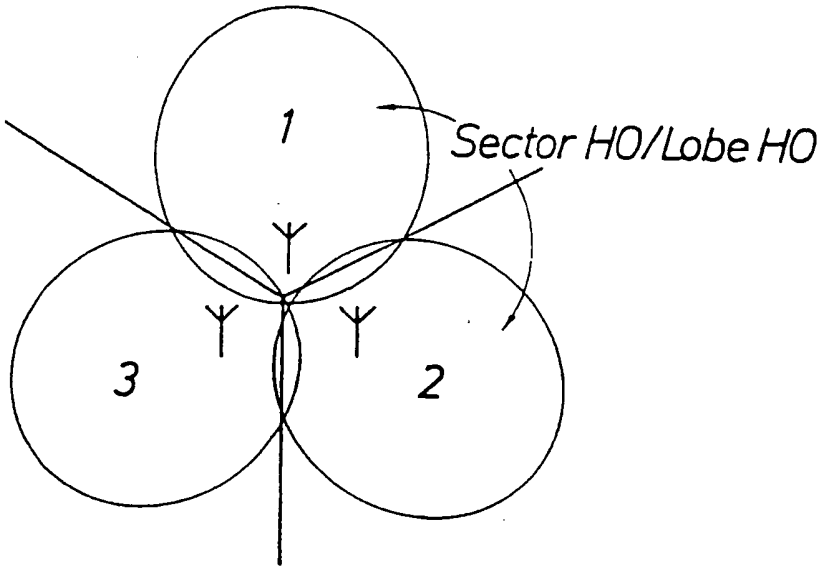

FIG. 5

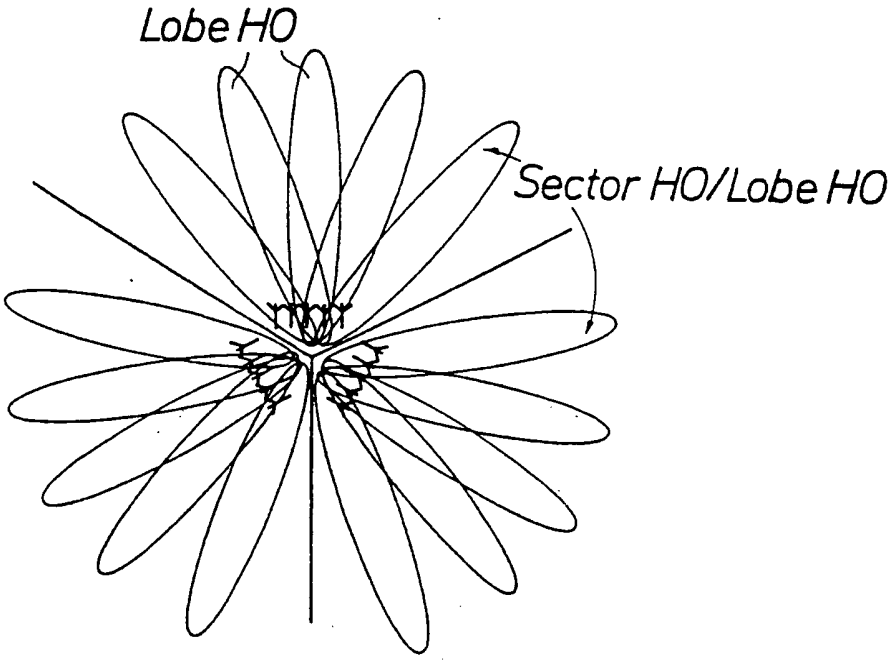

FIG. 6

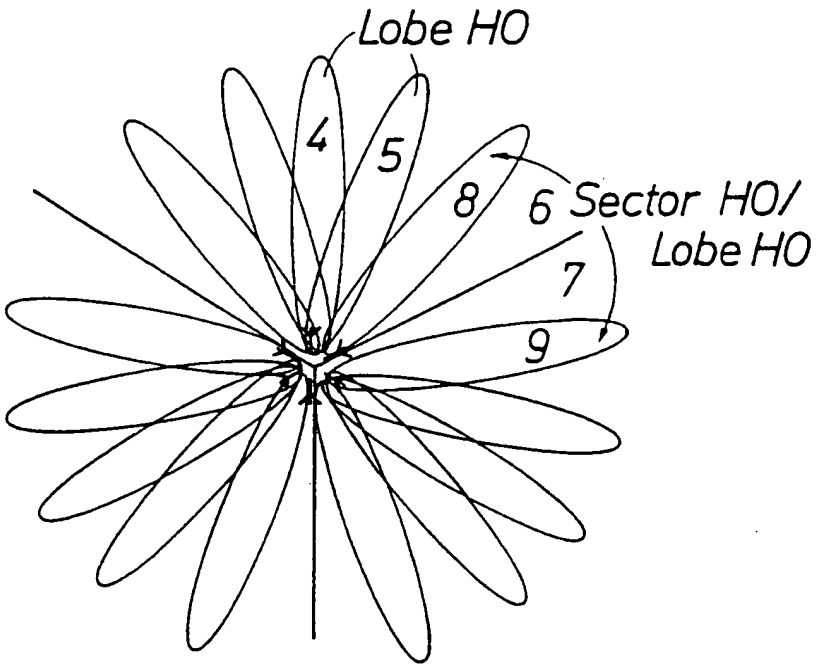

FIG. 7

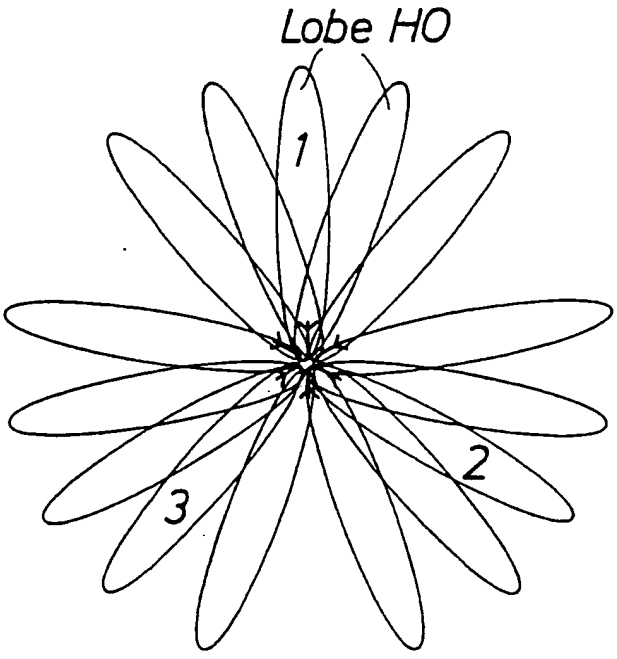

FIG. 8

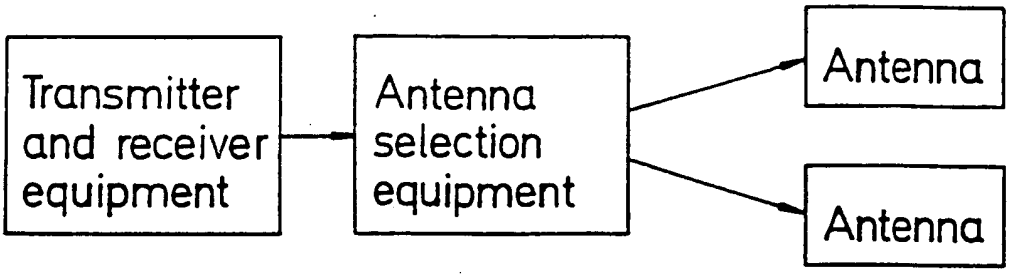
Transmitter and receiver equipment
Antenna selection equipment
Antenna
Antenna

FIG. 9

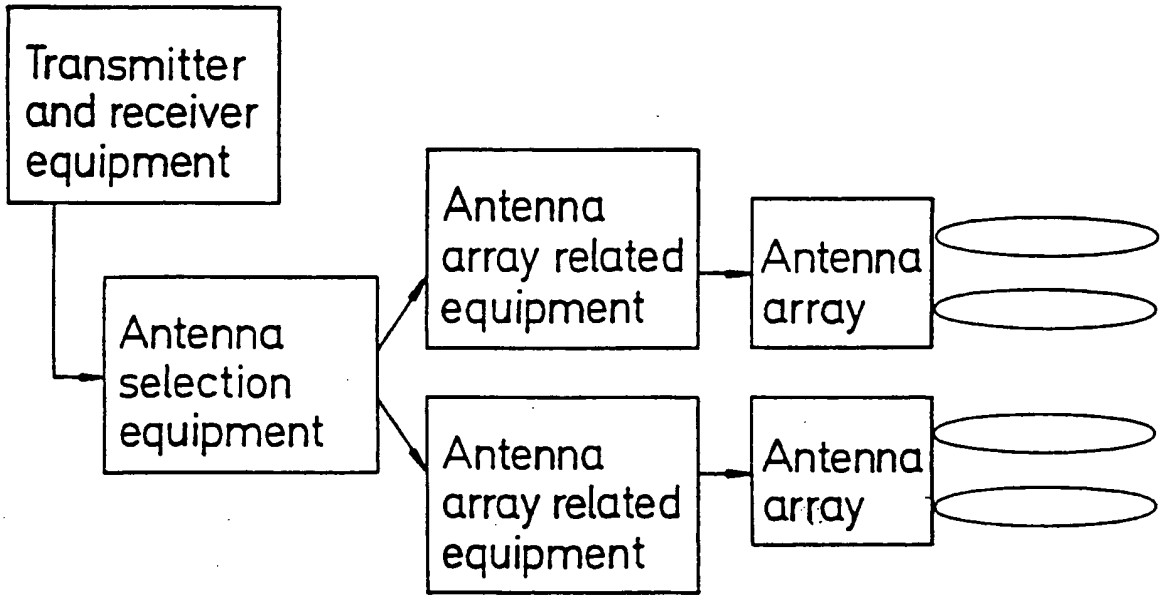
Transmitter and receiver equipment
Antenna selection equipment
Antenna array related equipment
Antenna array related equipment
Antenna array
Antenna array

FIG. 10

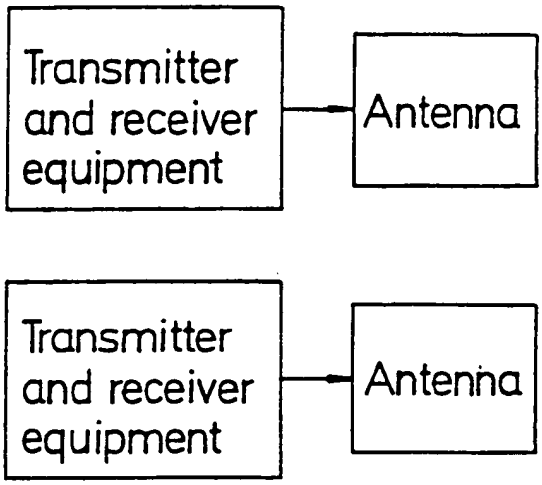
Transmitter and receiver equipment
Antenna
Transmitter and receiver equipment
Antenna

FIG. 11

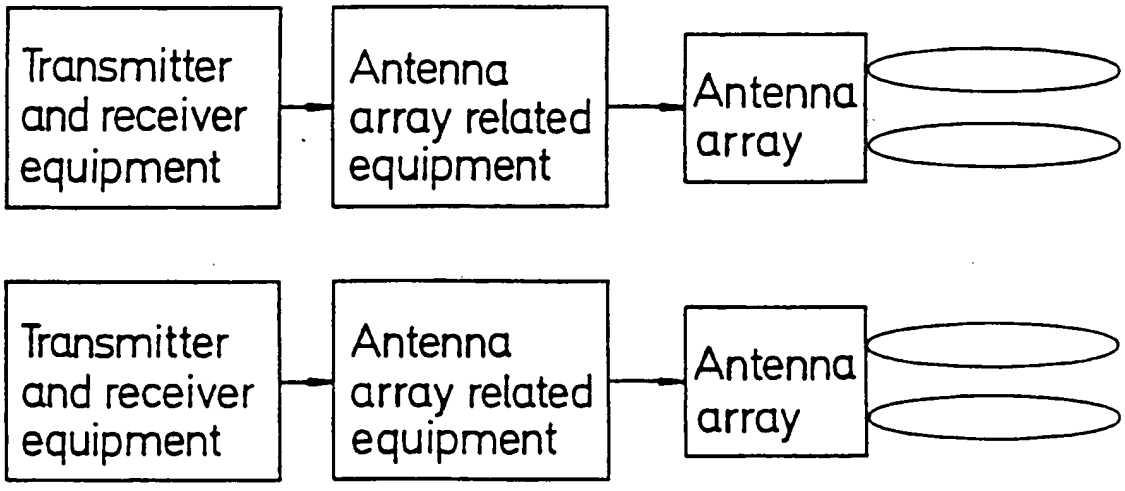
Transmitter and receiver equipment
Antenna array related equipment
Antenna array
Transmitter and receiver equipment
Antenna array related equipment
Antenna array

FIG. 12